

Trace-element partitioning between apatite and carbonatite melt

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ABSTRACT

To establish more fully a basis for quantifying the role of apatite in trace-element fractionation processes, hitherto unknown mineral/melt partition coefficients ($D^{\text{apatite/melt}}$) for a variety of trace elements (Li, Be, B, K, Cs, Rb, Ba, Th, U, Nb, Ta, La, Ce, Sr, Pr, Hf, Zr, Sm, Gd, Y, Lu, and Pb) have been measured between fluorapatite [$\text{Ca}_5(\text{PO}_4)_3\text{F}$], chlorapatite [$\text{Ca}_5(\text{PO}_4)_3\text{Cl}$], and hydroxylapatite [$\text{Ca}_5(\text{PO}_4)_3\text{OH}$] and carbonatite melt.

Apatites were equilibrated experimentally with carbonatite melts at 1 GPa and 1250 °C, and run products were analyzed for trace elements by secondary ion mass spectrometry (SIMS) and by laser ablation inductively coupled plasma-mass spectrometry (LA-ICP-MS). Calculated partition coefficients indicate incompatibility of most analyzed elements. Rare-earth element (REE) partition coefficients show a convex-upward pattern, indicating that apatite prefers the middle (Sm, Gd) relative to the lighter (La, Ce, Pr) and heavier REE (Lu).

Comparison of partition coefficients determined in this study with previous results in silicate systems reveals a strong influence of melt chemistry on partition coefficients, namely decreasing partition coefficients with decreasing silica-content, and increasing Ca and P in melts.